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14. ABSTRACT

This research, originally scoped for three years, was to test hypotheses about memory and sensory modalities; specifically, does a walk-around Virtual Reality interface improve performance in memory and other tasks when compared other interfaces?

The first year of the grant was spent designing, engineering, and debugging an infrastructure for a wireless virtual reality system that allowed a large, free-range full body interface, and a framework for running experiments using this apparatus.

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Final Report: A Natural Locomotion Virtual Environment Testbed

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Research Problem and Approach

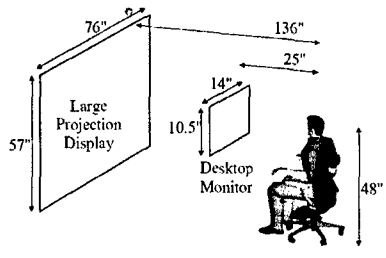
This research, originally scoped for three years, was to test hypotheses about memory and sensory modalities; specifically, does a walk-around Virtual Reality interface improve performance in memory and other tasks when compared other interfaces?

The first year of the grant was spent designing, engineering, and debugging an infrastructure for a wireless virtual reality system that allowed a large, free-range full body interface, and a framework for running experiments using this apparatus.

A major goal was to test various hypotheses about whether moving one's body through space aided in memory, especially for navigation.

Another goal was to determine to what degree physical performing various actions during training, and/or watching a virtual reality avatar during training, aided one's ability to perform those actions in a post-training scenario. Related questions included whether a basic human behavior such as enactment can be used as a metric for assessing the quality of motion, rendering style, and interactivity of virtual reality avatar?

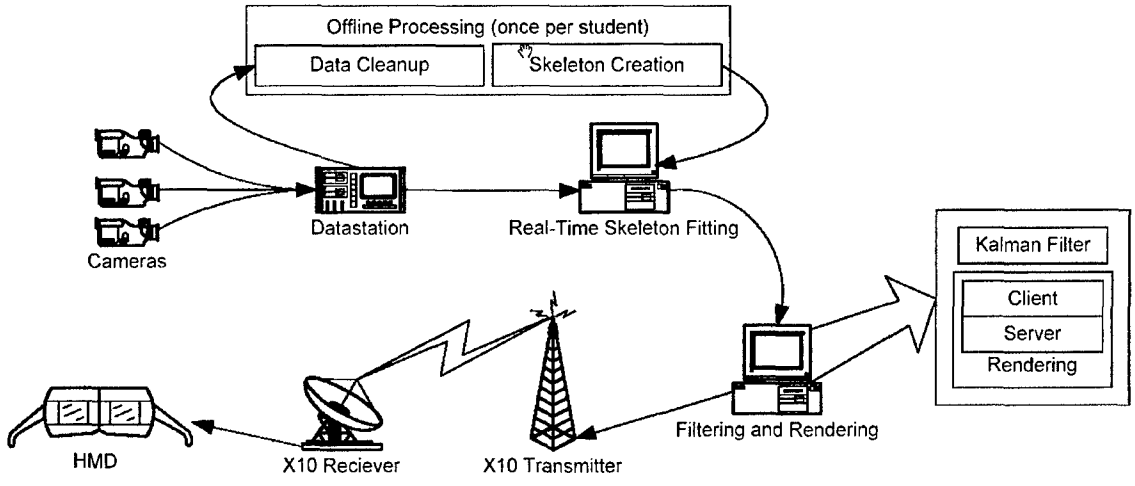
Much of this work was inspired by Desney Tan's results, which showed that users had a larger sense of engagement, or "presence" when view scenes on a larger, life-scale display (as opposed to a desktop display), even though the visual angle subtended was identical (as shown on the figure to the right).



Technical Accomplishments

We were able to construct the largest wireless (tracking area of 4x5x2.3 meters), full-body tracking virtual reality system we are aware of. (Shown in figure to the right). This system allowed tracking of not only the user's body, but also hand-held or free-standing props, such as a gun that could be picked up, a beach ball that could be tossed back and forth, and a chair that could be moved in the environment, and then sat or stood upon. One of our major findings is that haptic feedback based on these kinds of objects hugely improves the sense of presence in the virtual environment.

The system used a Vicon motion capture system that we put into a real-time data capture mode; that 3d tracker information was run through a kalman filter and fed into the Panda3D graphics engine (www.panda3d.org) that is jointly developed by Carnegie Mellon and Walt Disney Imagineering. The output was downsampled to NTSC and broadcast wirelessly as a short-range, low-power television signal. The architecture of the system is show in the diagram below:



Research Accomplishments

With the remaining time in the first year of this grant, we were able to perform several informal pilot studies with mostly inconclusive results. We were able to partially replicate the SIGGRAPH 1997 research by Pausch and Proffitt regarding letter searching, and adapted that "surround search" to a memory paradigm where subjects looked for pairs of symbols, as in the game "concentration."

Some of the ideas that we developed in this later influenced some work on human-robot (as opposed to human-avatar) interaction.

Publications that Led from This Work:

Mutlu, B., Osman, S., Forlizzi, J., Hodgins, J., Kielser, S. (2006). Task Structure and User Attributes as Elements of Human-Robot Interaction Design. In Proceedings of the 15th IEEE International Symposium on Robot and Human Interactive Communication (Ro-Man 2006), September 2006, University of Hertfordshire, Hatfield, United Kingdom.

Mutlu, B., Osman, S., Forlizzi, J., Hodgins, J., Kielser, S. (2006). Perceptions of ASIMO: An exploration on co-operation and competition with humans and humanoid robots. In Extended Abstracts of the Human-Robot Interaction Conference (HRI'06), March 2006, Salt Lake City, UT, USA

Financial

$99,937.67 of the funded $100,000.00 was spent. The funding was not available for the remaining two years of the grant.